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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/620,002	07/14/2003	Dinesh Chopra	2269-4373.2US (00-0036.02	7481

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EXAMINER	
UMEZ ERONINI, LYNETTE T	

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 09/06/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/620,002	CHOPRA ET AL.	
	Examiner	Art Unit	
	Lynette T. Umez-Eronini	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 June 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-25* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *14 July 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

This communication is in response to Applicants' Remarks (in Amendment filed 6/24/2005), which were persuasive in showing the Chopra et al. (US 6,419,554) reference failed to qualify as prior art under 35 U.S.C. 103 (a) in the rejection of claims 12-14 and 21-25, Hence a new office action is presented.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-11, and 15-19 are rejected under 35 U.S.C. 102(b) as being anticipated by Hudson (US 5,972,792).

Hudson teaches a method of chemical-mechanical planarization of a substrate on a fixed abrasive polishing pad in which a planarizing solution is dispensed onto the pad (Abstract). The planarizing solution may be used to planarized titanium and aluminum on a tungsten plug, a titanium nitride barrier layer (column 4, lines 1-25) and copper (column 4, lines 50-52); has a pH of between 3.0 and 10.0 (column 4, lines 53-54); includes an oxidant such as ferric nitrate, hydrogen peroxide, potassium iodate, and bromine (column 4, lines 35-37 and 53-56); and has a mixture of 0.1%-1.0% benzotriazole, 0.1%-5.0% nitric acid, and deionized water (column 4, lines 56-65). The above read on,

A slurry for use in polishing a copper structure of a semiconductor device, the slurry being substantially free of abrasives.

Since Hudson uses a composition that is substantially free of abrasives as claimed by applicants, then using Hudson's slurry in the same manner as claimed in the present invention would inherently result in the slurry being formulated to substantially concurrently polish copper and a barrier material with the barrier material being removed at substantially the same rate as or at a slower rate than copper is removed, as **in claim 1**;

being formulated to oxidize copper at substantially the same rate as or at a faster rate than the barrier material is oxidized, **in claim 3**;

wherein, in the slurry, the barrier material and copper have substantially the same oxidation energies, **in claim 4**;

wherein, in the slurry, the barrier material has an oxidation energy of about 0.25 V more to about 0.20 V less than an oxidation energy of copper in said slurry **in claim 5**;

wherein, in the slurry, a rate of removal of the barrier material is up to about ten times slower than a rate of removal of copper, **in claim 6**;

wherein, in the slurry, a rate of removal of the barrier material is about two to about four times slower than a rate of removal of copper, **in claim 7**;

wherein the slurry is formulated to remove copper and the barrier material without substantially dissolving the barrier material that underlies remaining portions of copper, **in claim 8**;

wherein the slurry comprises at least one oxidizer, at least one pH control agent, and at least one inhibitor, **in claim 9**;

wherein the at least one oxidizer comprises at least one of an ammonium compound, a nitrate compound, and an amine compound, **in claim 10**; and

wherein the at least one oxidizer comprises at least one of hydrogen peroxide, potassium iodate, potassium permanganate, ammonium persulfate, ammonium molybdate, ferric nitrate, nitric acid, potassium nitrate, and ammonia, **in claim 11**.

Hudson also teaches planarizing with a silica-ceria fixed abrasive polishing pad (column 4, lines 38-39), which reads on the slurry being formulated for use with a fixed-abrasive polishing pad comprising at least one of aluminum dioxide, titanium dioxide, silicon dioxide, and cerium dioxide, **in claim 2**;

The said above also encompasses,

wherein the slurry has a pH of about 2 to about 6, **in claim 15**;

wherein the at least one inhibitor comprises about 0.05% to about 2% of the weight of said slurry, **in claim 18**; and

wherein the at least one inhibitor comprises about 0.05 to about 0.2% of the weight of said slurry, **in claim 19**.

The said above also reads on,

wherein the at least one inhibitor comprises at least one of an azole, an amine, and a ring compound, **in claim 16**; and

wherein the at least one inhibitor comprises at least one of benzenetriazole (BTA), mercaptobenzothiazole, tolytriazole, methylamine, diethylamine, pyridine,

quinoline, dicyclohexamine nitrate, potassium silicate, ammonium borate, ammonium phosphate, and potassium dichromate, **in claim 17**.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 12-14 and 21-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hudson (US '792) as applied to claim 1 above, and further in view of Nakazato et al. (US 4,459,216).

Hudson differs in failing to teach at least one pH control agent as recited in claim 14; and to specify the percent by weight of the oxidizer as recited in claims 12-13 and

23-24 and the complexing agent as recited in claims 21-22 and the temperature as recited in claim 25.

Nakazato teaches a chemical dissolving solution that is used in chemical polishing of metals such as copper. The chemical dissolving solution comprises hydrogen peroxide, an inorganic acid such as sulfuric, phosphoric, and nitric acid and an aromatic compound (Abstract; column 1, lines 5-15 and 28-33; and column 3, lines 12-24). The chemical dissolving solution includes 5g/l – 100 g/l (~0.1 to 10 %) of hydrogen and 100 g/l – 300 g/l of inorganic acid for polishing copper (column 3, lines 34-41) and can be used at a temperature of 10° - 80°C (column 3, lines 56-58). Nakazato also discloses a reference, which teaches a chemical polishing solution for copper, which comprises 0.5-30 % (w/w) sulfuric acid, 5-60% (w/w) hydrogen peroxide, and at least 0.1% (w/w) of an amine such as benzotriazole are used (column 1, lines 43-52).

Since the Nakazato reference is relied upon to teach an abrasive free solution comprising the specific concentration of oxidizer and complexing agent and operating temperature, which are known, then it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Hudson by using Nakazato's concentration of oxidizer and complexing agent as well as temperature that would effectively accomplish the applicants' disclosed slurry because it has been held that there is no invention where the difference in proportions is not critical and was ascertained by routine experimentation because the determination of workable ranges is not considered inventive. See In re Swain and Adams, 70 USPQ 412 (CPA 1946).

6. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nakazato (US '216) as applied to claim 1 above, and further in view of Okinaka (US 4,349,411).

Nakazato differs in failing to teach at least one complexing agent comprising at least one of glycine, ammonium citrate, ammonium phosphate, and ammonium acetate.

Okinaka teaches useful complexing agents for copper includes glycine.

Since Okinaka illustrates a complexing agent is known, then it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Nakazato by employing a chelating agent as taught in the Okinaka reference that would effectively accomplish the disclosed composition.

Response to Arguments

7. Applicant's arguments filed 6/24/2005 have been fully considered but they are not persuasive. Applicants traverse the 102(b) rejection of claims 1-11 and 15-19 for failing to expressly and inherently teach a slurry that is useful for polishing copper and a barrier material with the barrier material being removed at substantially the same rate or at a slower rate than copper is removed, **in claim 1**; is formulated to oxidize copper at substantially the same rate as or at a faster rate than the barrier material is oxidized, **in claim 3**; in which the barrier material and copper have substantially the same oxidation energies, **in claim 4**; in which a barrier material has an oxidation energy of about 0.25 V more to about 0.20 V less than an oxidation energy of copper **in claim 5**; in which a rate of removal of the barrier material is up to about ten times slower than a rate of removal

of copper, **in claim 6**; in which a rate of removal of the barrier material is about two to about four times slower than a rate of removal of copper, **in claim 7**; and is formulated to remove copper and the barrier material without substantially dissolving the barrier material that underlies remaining portions of copper, **in claim 8**.

Applicants' argument is unpersuasive because Hudson uses a composition that is substantially free of abrasives as claimed by applicants. Hence, using Hudson's slurry in the same manner as claimed in the present invention would inherently result in the slurry being formulated as recited above in claims 1-8.

8. Applicant's arguments, see pages 4-5 of Remarks filed 6/24/2005, with respect to the rejection(s) of claim(s) 12-14 and 21-25 under 35 U.S. C. 103(a) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of newly found prior art, which teaches at least one pH control agent as recited in claim 14; and to specify the percent by weight of the oxidizer as recited in claims 12-13 and 23-24 and the complexing agent as recited in claims 21-22 and the temperature as recited in claim 25.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 571-272-1470. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Art Unit 1765

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August 30, 2005

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER